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(54) **AREA VACUUM GRIPPER**

(71) Applicant: **J. Schmalz GmbH**, Glatten (DE)

(72) Inventors: **Leonhard Harter**, Loβburg (DE); **Ken Steyerl**, Nagold (DE)

(73) Assignee: **J. Schmalz GmbH**, Glatten (DE)

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CPC ***B25J 15/0616*** (2013.01); ***B25J 15/0691*** (2013.01); ***B25J 19/00*** (2013.01); ***B65G 47/91*** (2013.01); ***B65G 47/917*** (2013.01)

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USPC 294/185, 183, 188; 901/40
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,910,621 A 10/1975 Hillier
4,265,476 A * 5/1981 Elgart B25B 11/007 269/21
4,703,966 A 11/1987 Lewecke et al.
(Continued)

FOREIGN PATENT DOCUMENTS

DE 3636523 A1 5/1988
DE 19817217 C1 8/1999
(Continued)

OTHER PUBLICATIONS

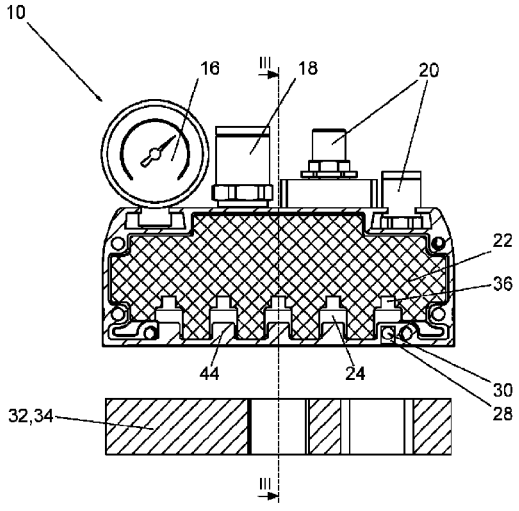
International Search Report and Written Opinion of the International Searching Authority mailed May 6, 2014 in PCT International Application No. PCT/EP2014/051089.

Primary Examiner — Gabriela Puig
(74) *Attorney, Agent, or Firm* — Howard & Howard Attorneys PLLC

(57) **ABSTRACT**

A surface area vacuum gripper for sucking and handling workpieces, comprising a housing, in which a negative pressure vacuum chamber is provided that can be subjected to negative pressure and wherein the housing includes suction openings on the suction side, facing the workpiece. An insertion element is provided in the housing, which reduces the free inner space of the housing and includes vacuum channels fed by a vacuum generator. The insertion element can be equipped with a plurality of optional functions.

7 Claims, 1 Drawing Sheet



(56) **References Cited**

U.S. PATENT DOCUMENTS

4,881,770	A	11/1989	Marzinotto et al.	
5,259,859	A *	11/1993	Claassen	C03B 40/005 294/188
5,749,614	A *	5/1998	Reid	B65G 47/91 414/627
7,661,736	B2 *	2/2010	Schmalz	B25J 15/0616 294/183
8,251,422	B2 *	8/2012	Cheng	H01L 21/67333 294/183
2008/0129062	A1	6/2008	Schmalz et al.	
2015/0360371	A1 *	12/2015	Harter	B25J 15/0616 294/186

FOREIGN PATENT DOCUMENTS

DE	10216221 C1 *	10/2003	B26J 15/0616
DE	102005014115 A1	9/2006	
DE	102006013970 A1	9/2007	
DE	102006050970 A1	4/2008	
EP	0267874 A1	5/1988	

* cited by examiner

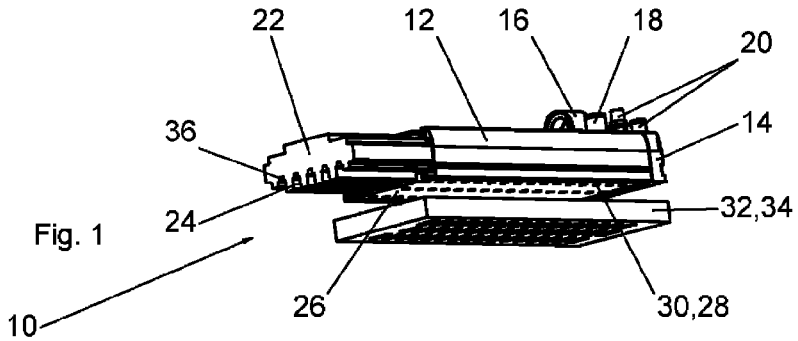


Fig. 1

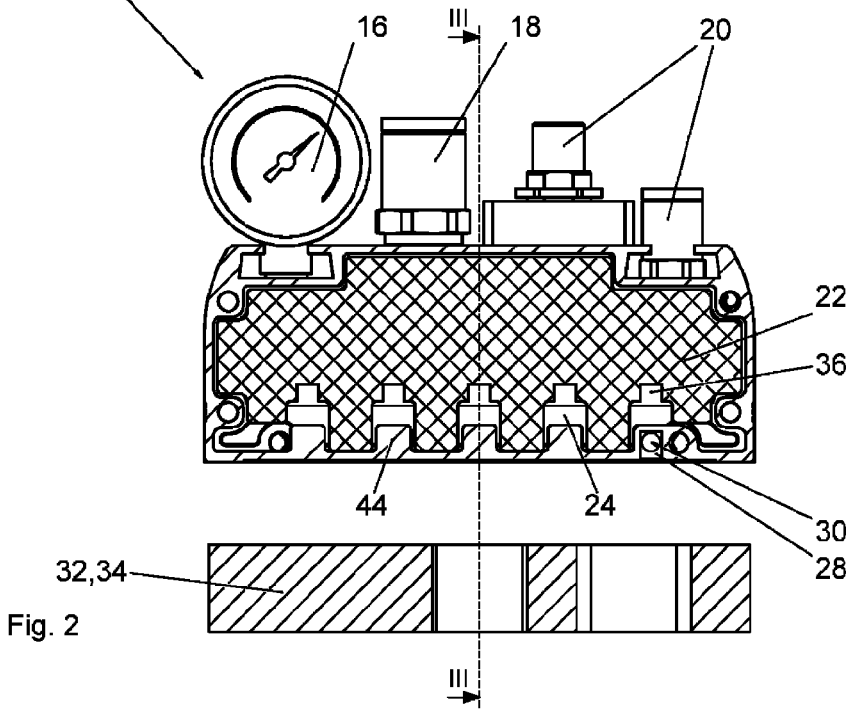


Fig. 2

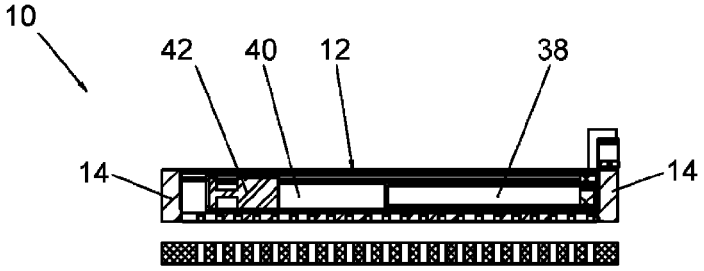


Fig. 3

AREA VACUUM GRIPPER

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a National Stage of International Patent Application No. PCT/EP2014/051089, filed on Jan. 21, 2014, which claims priority to and all the benefits of German Patent Application No. 10 2013 201 248.9, filed on Jan. 25, 2013, both of which are hereby expressly incorporated herein by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a surface area vacuum gripper for sucking onto and handling workpieces, with a housing, which is provided with a negative pressure chamber that can be acted upon with negative pressure and the housing comprises suction openings on its side facing the workpiece.

2. Description of the Related Art

Surface area vacuum grippers serve in particular for gripping and lifting of objects, such as positionally stable flat materials, such as boards or plates, or smaller objects, such as cans, cups, dishes or the like. The surface area vacuum gripper comprises a flexible lining, which is usually applied to the top side of the objects to be gripped. Foam lining has proven as advantageous, because it conforms well to the sometimes uneven surface. There is, however, still the problem that different objects have different surfaces and sometimes large gaps exist between the objects.

However, the flow behavior of the conventional suction grippers is too slow to quickly respond to different objects.

If the surface area vacuum gripper is equipped with flow valves with a predetermined suction, the valve bodies must not be too sluggish, because otherwise they do not close. Fast-acting valve bodies carry the risk that they will close when a sucked-on workpiece e.g. is briefly lifted by vibration so that briefly ambient air is sucked in. In this case, the workpiece would drop.

Publications U.S. Pat. No. 7,661,736 B2, DE 36 36 523 C2, DE 198 17 217 C1, DE 10 2006 050 970 A1, U.S. Pat. No. 3,910,621 A and EP 0 267 874 A1 describe surface area vacuum grippers, in which components are arranged in the negative pressure chamber.

SUMMARY OF THE INVENTION

The present invention therefore has for its object to further develop a suction gripper surface of the aforementioned type in such a way that even slow-closing valves can be used.

According to the invention, this technical task is solved with a surface area vacuum gripper wherein an insert element is disposed in the housing, which reduces the free inner space of the housing and includes negative pressure channels supplied by a generator of negative pressure. Further features become evident from dependent claims.

According to the invention, the insert element reduces the negative pressure chamber within the housing and thus improves the responsiveness of the surface area vacuum gripper. Since the dead space is reduced by the insert element, each individual suction opening responds better even for a smaller suction volume flow. It is not a large suction volume that needs to be evacuated. Any present flow valves may be designed in their closing behavior in a sluggish manner. This design of the flow valves thus allows a reliable lifting and transportation of objects without the existence of the danger that the valve closes during the lifting procedure due to leakage on the surface of the sucked-on object. The invention thus ensures the transportation of objects with leakage with a minimal use of the total volume flow.

Another advantage consists in the fact that the surface area vacuum gripper can be quickly adapted to different purposes by different insert elements in that the suitable insert element is inserted into the housing. This allows complementing or changing the functions. The surface area vacuum gripper is designed in the fashion of a construction kit.

In a further development of the invention, the insert element includes negative pressure channels designed as grooves on its bottom side facing the suction side of the housing. These negative pressure channels are connected to the generator of negative pressure and form with the feeding lines quasi the only dead space connected with the suction openings. Its volume depends solely on the dimensions of the grooves and the feeding lines and can therefore be kept very small.

To prevent a breakdown of the whole negative pressure system caused by leakage or unoccupied suction openings, the grooves can be sealed from each other. In addition, the grooves themselves can comprise one or more dividers over their length.

The housing can be frontally closed and the insert element can be frontally inserted into the housing and pulled out again. Advantageously, the housing is an extruded profile, wherein the grooves extend in the longitudinal direction of the housing or its extruded profile. The grooves can therefore be formed during the manufacturing of the housing, wherein they protrude on the inner side of the suction side of the housing. If the insert element is inserted into the housing frontally, the studs mesh into the grooves of the insert element.

In one embodiment of the invention, the insert element includes at least a receiving chamber e.g. for an ejector or a multi-stage ejector for a pressure reservoir or a negative pressure reservoir. The pressure or negative pressure reservoir can be formed directly in the insertion channel. In this manner, negative pressure is immediately present at the suction openings and, if needed, can be quickly released by the pressure stored in the pressure reservoir. Using the higher pressure, any impurities can also be blown out. A further development provides that electrical components such as valves, sensors, energy storage, cameras, controllers, etc., are mounted within or on the insert element.

An advantageous embodiment provides that the insert element includes at least one lighting device. The lighting device illuminates the negative pressure channel and one or more suction openings and shines from the inside to the outside. The surface area vacuum gripper can thus illuminate the surface of the object to be gripped before it touches down on it, which is of great advantage in particular in insufficiently lit workplaces. In addition or as an alternative, in the insert element and in particular in the suction openings reflectors can be provided. If the suction openings are illuminated from outside, any dirt can be easily recognized.

With preference, the invention further provides that the insert element comprises at least one compressed air channel and/or compressed air nozzles. On the one hand, by these compressed air nozzles dirt can be easily blown out, on the other hand it serves to release the gripped workpiece.

In another embodiment, the insert element has at least one electrically driven pump for generating vacuum. In this

variant, the supply line for compressed air and/or negative pressure is omitted. It only requires electrical supply leads.

To be able to operate this surface area vacuum gripper at least in the short term even without a connection to the mains supply, the insert element comprises at least one energy storage device, for example, an accumulator. It operates the electric pump and can later be recharged.

Further advantages, features and details of the invention become evident from the dependent claims and the following description, which describes a particularly preferred embodiment with reference to the drawing. The features shown in the drawing and mentioned in the description and in the claims can each be essential to the invention individually or in any combination.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings show:

FIG. **1** is an exploded view of the invented surface area vacuum gripper, partly cut;

FIG. **2** is a cross-section of the surface area vacuum gripper; and

FIG. **3** is a longitudinal section III-III according to FIG. **1** through the surface area vacuum gripper.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. **1** is shown in perspective view a surface area vacuum gripper **10**, which includes a housing **12**, which is for example a section of an extruded profile. Alternatively the housing **12** can also be a bent sheet metal part, 3D compression-molded part, CFRP part or a cast part. The housing **12** is closed frontally by two end caps **14**. At the end cap **14** shown in FIG. **1**, there is a pressure gauge **16**, a pressure air connection **18** and further connections **20**, which are not essential for the invention. In housing **12** is located an insert element **22**, which reduces the free interior of the housing **12** and conforms to the inner surface of housing **12** as close as possible, but still has so much play to it that it can be inserted into the housing **12** and removed again, i.e. it can be pulled out. The insert element **22** has negative pressure channels designed as grooves **24** on its underside. Corresponding to these grooves **24**, the housing **12** has at its bottom **26** several rows with suction openings **28** which are designed as flow resistance or serve for receiving flow valves **30**, for example, valve balls or the like. To the bottom **26** is attached a flexible lining **32**, which is formed by a foam pad **34** or a sealing plate. This lining **32** is formed porous or into this lining **32** is introduced a plurality of slots or apertures which in turn spatially correspond with the suction openings **28**.

Further, it can be seen in FIG. **2** that on the inside of the bottom **26** extend studs **44**, in which the suction openings **28** are provided and by which the individual grooves **24** are sealed from each other. Above the grooves **24** are recesses **36**, in which, for example, lighting bodies, reflectors, blow-off nozzles and/or the like may be used. These recesses **36** are located in the extension behind the suction channels or suction openings **28**.

FIG. **3** shows in the longitudinal section III-III the insert element **22** in the housing **12** and there is also illustrated a vacuum generator **38**. This vacuum generator **38** is directly connected to the end cap **14** so that through this cap the inlets and outlets for fluids and electric power as well as data can be conducted. The insert element **22** is formed as a hollow body **40** and serves as a reservoir for compressed air or as a vacuum reservoir. In this case, the vacuum generator is inserted directly into the insert element **22**. The hollow body **40** designed as a vacuum reservoir has an opening closable with a flap in the direction of the flow openings **28**. The flap can be opened with a cylinder **42** so that vacuum is abruptly created at the flow openings **28**. This has the particular advantage that even slowly reacting valves can be used. In addition, a memory may be integrated in the insert element **22** as a separate component.

The invention has been described in an illustrative manner. It is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation. Many modifications and variations of the invention are possible in light of the above teachings. Therefore, within the scope of the appended claims, the invention may be practiced other than as specifically described.

What is claimed is:

1. A surface area vacuum gripper for sucking onto and handling of workpieces, said surface area vacuum gripper comprising:

a frontally closable housing having a negative pressure chamber which can be exposed to vacuum, said housing includes suction openings on its suction side facing the workpiece, and an insert element disposed in the housing and configured to be frontally inserted into and again pulled out from the housing, which insert element reduces the free inner space of the housings and includes vacuum channels supplied by a vacuum generator, wherein the vacuum channels are configured as grooves on the bottom side of the insert element facing the suction side of the housing, wherein the grooves are sealed from each other, and wherein the housing is an extruded profile and wherein the grooves extend in longitudinal direction of the housing and the profile, and wherein fillets are provided on the inner side of the suction side of the housing, which protrude into the grooves of the insert element.

2. The surface area vacuum gripper as set forth in claim **1**, wherein the insert element includes at least one receiving chamber configured to receive a vacuum generator or a pressure reservoir or a vacuum reservoir.

3. The surface area vacuum gripper as set forth in claim **1**, wherein the insert element includes recesses above the grooves, wherein at least one illumination device is disposed inside at least one of the recesses.

4. The surface area vacuum gripper as set forth in claim **3**, wherein the illumination device is configured to illuminate the vacuum channel and/or one or more suction openings.

5. The surface area vacuum gripper as set forth in claim **1**, wherein the insert element includes recesses above the grooves, wherein at least one blow-off nozzle is disposed inside at least one of the recesses.

6. The surface area vacuum gripper as set forth in claim **1**, wherein the insert element includes at least one electrically driven pump for the generation of vacuum.

7. The surface area vacuum gripper as set forth in claim **1**, wherein the insert element includes at least one energy reservoir configured as an accumulator, and/or at least one sensor, and/or at least one camera.

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